THE VENUS EMISSIVITY MAPPER – INVESTIGATING THE ATMOSPHERIC STRUCTURE AND DYNAMICS OF VENUS' POLAR REGION.

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Introduction: The Venus Emissivity Mapper (VEM) is the first flight instrument specially designed to map the surface of Venus using the narrow atmospheric windows around 1 µm [1]. VEM is proposed for the European Space Agency's M5/EnVision proposal in combination with a high-resolution radar mapper (*see Abstract* #1937). Mapping of Venus with VEx/VIRTIS using the 1.02 µm thermal emission band can be viewed as a proof-of-concept for an orbital remote sensing approach to surface composition and weathering studies for Venus [2-7].

Thermal brightness on Venus' night side is mainly modulated by the lower clouds, imaged at 2.3 µm by the Akatsuki IR2 camera [8]. Thanks to the circular polar orbit geometry of M5/EnVision, VEM has the unique capability to (1) better constrain the microphysics of the lower cloud particles in three spectral bands at 1.195, 1.310 and 1.510 µm at a spatial resolution of ~10 km, and (2) investigate short-timescale cloud dynamics and thus local wind speeds by tracking cloud features in both polar regions.

Cloud parameters: Global cloud layers (~45 to 70 km) drive the energy balance of the atmosphere and hence climate at the Venus' surface [9]. While much progress has been made since the early suggestion that the Venus clouds are H_2O-H_2SO_4 liquid droplets [10], several cloud parameters are still poorly constrained, particularly in the lower cloud layer and optically thicker polar regions [11-13]. Observations at small horizontal scales are of great importance to microphysical models of cloud and haze systems [14]. VEM has the capability to better constrain the microphysics (vertical, horizontal, time dependence of particle size distribution, or/and composition) of the lower cloud particles in three spectral bands at 1.195, 1.310 and 1.510 µm at a spatial resolution of ~10 km.

Wind measurements: Venus displays the best-known case of polar vortices evolving in a fast-rotating atmosphere. Few wind measurements exist in the polar region due to unfavorable viewing geometry of currently available observations. Cloud-tracking data indicate circumpolar circulation close to solid-body rotation. E-W winds decrease to zero velocity close to the poles. N-S circulation is marginal, with extremely variable morphology and complex vorticity patterns [15-17] (Fig. 1). Circular polar orbit geometry would provide an unprecedented study of both polar regions within the same mission. VEM's pushbroom method will allow short-timescale cloud dynamics to be assessed, as well as local wind speeds, using repeated imagery at 90 minute intervals.

Tracking lower cloud motions as proxies for wind measurements at high spatial resolutions will greatly benefit modeling of the vortices' physics. Convective modeling demonstrates that there will be cloud-level

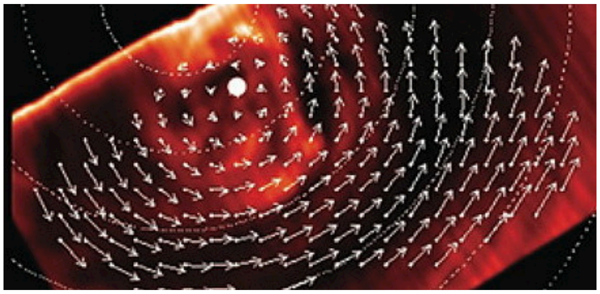

Figure 1 - Polar projection of South vortex morphology and cloud tracking zonal wind velocities near 1.74 µm [17].

convection at high latitudes, so repeated imagery at 90 minute intervals will help constrain the time evolution of cloud-level convection as well as wave-generating dynamical instabilities [17]. This will also allow a direct comparison of the N-S wind regimes and their temporal evolution at several time scales.

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